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ABSTRACT

The argument for technology education and its relationship and relevance to teacher education courses is presented, and centers around three assumptions: (1) The term technology education can be defined, (2) technology has permeated our society, and (3) industrial arts education might not be able to withstand the complexities of a technological society. Viewpoints concerning the definition of technology education (assumption 1) are reviewed; the relevant consistencies among these definitions are enumerated, and a new definition is offered. Basic concern is then centered on the growth and expansion of technology in twentieth century United States and the implications that this has for industrial arts curriculum (assumption 2). It is noted that as a result of this growth, a need has developed for review of the directions that industrial arts has and will be taking (assumption 3). It is concluded that the responsibility for educational programs to reflect cultural trends and therefore technology exists, and that much of the apprehension would be dismissed if technology were considered a process rather than a thing. Also included in the paper is a rationale and outline of a technology education curriculum. (TM)

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Special Session

Technology as Content: Can Teacher Education Cope?

Donald P. Lauda

> So far as the mere imparting of information is concerned, no university has had any justification for existence since popularization of printing in the fifteenth century.
>
> \- Alfred North Whitehead

This presentation, as indicated by its title, deals with the future. Its intent is to seek plausible solutions for determining instructional content and instructional strategies for teacher education programs. This theme is a critical one as our society advances into the post-industrial era. The title implies several basic assumptions which are crucial as persons with various philosophies seek the optimum program for teacher education in industrial arts.

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These assumptions are:

- That the term technology is capable of being defined.
- That technology has permeated our society and is therefore worthy of consideration for curricular efforts.
- That the industrial arts profession might not be able to withstand the complexities of a technological society.

Since the late 1960's industrial arts educators have made a concerted effort to generate programs based upon the study of technology. This movement has met resistance in many cases. The debate has been enhanced by those who feel that the term cannot be defined, by those who choose to place an adjective in front of the term (e.g. industrial technology), and those who totally reject the study of technology as a discipline base. The reader is encouraged to read the proceedings of the 32nd AIAA conference held in Louisville in 1970. In this volume, (pages 187-221) no less than thirteen educators discuss the issues in great detail.

Our first assumption, that is that technology can be defined, causes the greatest debate. Countless definitions have been offered by persons in many different disciplines. One consistent thread seems to permeate these, and that is, that technology is a process. Berger's definition (p. 191) probably summarizes this concept. He says:

> Technology is a field of systemized and accumulated knowledge, techniques and intellectual skills and their practical <u>application</u> in creating useful goods and services for mankind. This body of knowledge is derived from a detailed study of the nature, principles, practices and products of science and industry. It is interdisciplinary in nature and involves the <u>application</u> of most of the other disciplines in the solution of technical problems.

These definitions, including the one by Berger, reveal many other relevant consistencies. Among these are:

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- Inherent in the concept is human endeavor. That is to say that the products (and by-products) are created by humans.
- The result of the technologies is apparent in all cultures regardless of their age or stage of development.
- The technologies are based on the accumulation of knowledge which foster the innovative process.
- The technologies have an impact upon <u>all</u> disciplines.
- The technologies are a viable content source for industrial arts.

With these in mind the author offers the following definition for the term technology:

> A <u>process</u> undertaken by humans in all cultures (a cultural universal) which involves the systematic application of organized knowledge (synthesis) and tangibles (tools) for the perpetuation of their culture and society; the study of which must include an understanding of technical information, the innovative process and the concomitant socio-cultural impact.

The writer runs the risk of merely offering another definition which reeks with philosophical overtures but offers little rationale for altering traditional industrial arts. Therefore, it is necessary to elaborate on the definition, with the intent being to show that the study of technology (without a modifier) is viable and necessary if we are to prepare students for their future.

INVENTORY OF A CULTURE: A MEANS TO IDENTIFY REALITY

Curriculum theorists have consistently expressed the need to base teaching efforts on the realities of our culture. Today, the futurists are going one step further and telling us that it is the reality of the future that we must utilize as our base. Our culture is a social environment which evolves from human needs and competes with the physical environment and, in some cases, other cultures. New practices arise and if they

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contribute to the survival of the culture, they become constants (universals).

All cultures pass through many contingencies. These interdependencies and interactions inevitably lead to strain at two levels: between the old values and new values; and between different groups of people. Coping with this rapid change faces every person and it is the institutions which must give coping mechanisms for human survival. The educational system is in a key position for assisting in that process.

In 1976 the citizens of the United States live in the most highly developed nation in the world. Opportunities for the utilization of the most sophisticated innovations are in evidence. Granted these opportunities are not provided to all people, but these are social issues not technical ones. The point being made is that the process we call technology has advanced our technical expertise to the highest level evident on earth. Historians can provide many reasons for this fact. However, what is important is that our students cannot escape the technical and social growth of their culture. This growth is perpetuated by many factors, such as:

- R & D Funding. Fiscal year 1977 research spending with federal funds should increase 11% to a high of \$24.7 billion. Industrial Research magazine (Jones, p. 54) indicates that the total research budget in this country should reach \$34 billion.

- R & D Technique. Corporate research has taken over the innovative process in the growth of science and technology. Enhanced by phenomenal assets and access to information systems the super-corporations can expedite the innovation process. It is estimated that by 1990 a handful of super-corporations will produce over three-fourths of the United States GNP.

  Schoenholz and Terry (p. 60) report that of the 237 notable inventions starting with the screw for pumping water in the third century B. C. to inventions in 1943, literally every one was invented by one, two, or three individuals. However, when

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considering 15 of the most notable inventions between 1944 and 1960 we find that 10 are attributed to large organizations. The lessons of team research have been providing the impetus for rapid growth in the technologies.

- Information Systems. Keeping in mind that the process we call technology "feeds" on accumulated information, the reader must realize the magnitude of the world's knowledge. For example, the Library of Congress (Miele, p. 24) had accumulated by June 30, 1974, over 73,932,425 items. These holdings increase at the rate of two million per year.

  The authors of the volume referred to above (Bowker Annual of Library and Book Trade Information) emphasize the point that the knowledge explosion is so immense that the only means to cope is via collaboration with specialty libraries. Page 351 of this volume discusses the global scene when it refers to the 60,000 scientific and specialty libraries in the USSR.

- Interdependence. Due to the realization that we exist in the midst of "finite resources" and "infinite demands" vast expenditures in the science and technologies will be utilized to ensure survival. Reference is made to international ventures to generate and control the technologies.

It would be easy to continue this list to emphasize the highly touted growth of our technological prowess. Today, this seems almost passe'. One would have to be comatose in order to avoid conscious awareness of the realities of our culture. Perhaps the problem in our discipline is that the degree of awareness stifles curricular efforts. In any case, at this juncture the writer wishes to function with the assumption that:

- We live in a culture which is perpetuated through the human use of accumulated knowledge and tools.

- The process called technology will continue to escalate exponentially leaving our products (students) living in a culture unlike that of today.

- Humans are as much a product of their culture as of their genes.

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COPING

It was stated in the beginning of this paper that the theme of this session assumed industrial arts educators might not be able to cope with the technology of the 1970's and beyond. It is important to note that the writer says that educators might not be able to cope rather than saying industrial arts can or cannot. Industrial arts, like technology, is neutral. It is the human who creates. It is the human who must cope. Industrial arts is only what we make it.

What does it mean to cope? What does it mean to say that we can or cannot handle the exigencies generated by rapid change? Commonly, coping refers to dealing with the things as they come, or keeping equilibrium. Encounters require strategies for working out modes of adaptation. These require conscious consideration of needs and demands of the situation. Coping behavior can best be defined as purposive action designed to assist in adjusting to environmental circumstances. It does not consist of withdrawal from reality. Coping behavior thrives on informed understanding of the environment and the ability to distinguish between the possible and impossible.

To say that teachers in the discipline of industrial arts cannot cope with the technologies would imply one or more of the following:

- Technology is so vast, so complex, and so bewildering that no human can hope to understand its nature.
- Educators are incapable of seeking modes of adaptation.
- Educators are totally divorced from the realities of the world.
- The study of technology never has been, and never will be, the goal of industrial arts.

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Each of us have heard these non-coping expressions over and over again, especially the first and last statement. Psychologists refer to this as expressive behavior rather than coping behavior. Teacher educators have not been afforded the opportunity in many cases to explore the realities of our technological culture. Non-coping expressions, therefore, are not unexpected. These problems are not indigenous solely to industrial arts teachers. Other disciplines are experiencing the frustration of keeping pace with the world's technical knowledge which doubles every decade.

If educators agree that content should be derived from our culture, and that we live in a highly technologized society, they either address themselves to that technology or lose the right to condemn those who do. They also lose the right to perpetuate education for the past which most assuredly will be detrimental to the citizens of the 21st century. Since the "system" has created this dilemna, that is, placing the content and instructional strategies of industrial arts educators in a "holding pattern", it is the educational arena which has tolerated non-coping behavior. Educators are not at fault. This is what they were taught. Streichler and Ray (p. 27) put it on the line when they stated:

> Finally it is suggested that effective curriculum planning cannot be elicited from educational leaders who are captives of traditions, modes of thought, heritages, and value systems which are irrelevant to contemporary society and are incomprehensible to the youth of today. The determination of industrial arts content should not be rooted in the past, but should develop fresh stems to search out needs, tools, patterns, and future-oriented values.

The writer does not mean to imply that industrial arts is due for extinction. The implication is that it is in the most opportune position

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of its tenure. No discipline is addressing itself to the concept of technology from a technical and socio-cultural standpoint in the public schools. Yet millions of youngsters are being educated to survive in the inevitable technological society. They cannot escape this position. Keep in mind that the six year old of today will be thirty in the year 2000. The tools we give him today are supposed to prepare him to face that century.

Most curriculum projects in our discipline have dealt with the study of industry. Some projects advocate the study of industrial technology, finding the word industry too restrictive. Still others tout the study of technology without any modifiers. It is here that the debate begins. It is here that the question of whether industrial arts can cope takes on real meaning. On one hand the use of a modifier (e.g. industrial) implies the inability to cope with the totality called technology. On the other hand, one is left with the impression that all technical knowledge and the socio-cultural consequences can be compressed into a curriculum package. This appears to widen the philosophical chasm in the discipline of industrial arts.

Inevitably one must do his homework and take a stand on such an issue. One runs the risk of being chastised by his colleagues but healthy interchange of ideas is the only means of getting our discipline to pull together. To this writer it appears that our technological culture is so complex and so impregnated with the impact of technology that helping youngsters understand the interrelationships must be our priority. To isolate the study of industry as our discipline base, denies the student the right to see the relationships of the major endeavors of the human. Reference is made to those

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human activities which are constant in all societies (production, communication and transportation). Our society is now into the post-industrial revolution, thus making Ferkiss' technological myth now a reality. To discuss and experience the industrial enterprise of the 1960's does not even portend to acknowledge the movement from a goods producing economy to a service economy. Nor does it acknowledge new occupational structures or the axial principle of knowledge. The post-industrial revolution thrives on theoretical knowledge to perpetuate its growth. Therefore, work becomes knowledge based. Students need to learn how the knowledge in the technologies is stored, retrieved and utilized.

To many the study of technology appears to be an impossibility since it is so vast. They say one cannot teach all of the areas (e.g. medical technology, social technology, nuclear technology). With these expressions it becomes apparent that the concept of technology is completely misunderstood. To refer to specific technologies results in the use of modifiers once again, just as does the name Industrial Technology. It is imperative that the educator realize that technology is a process rather than a "thing". The formal definition presented earlier in this paper was:

> A process undertaken by humans in all cultures (a cultural universal which involves the systematic application of organized knowledge (synthesis) and tangibles (tools) for the perpetuation of their culture and society; the study of which must include an understanding of technical information, the innovative process and the concomitant socio-cultural impact.

Once we move into this mode of thinking our goal becomes one of interpreting the following:

- What circumstances led to the development of our technological culture. -

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. What was the innovative process for generating ideas, tools, etc.

. How did/does the identified innovation function (technically).

. What contribution did the process have on culture and society.

. What is the future impact of our actions?

Through this approach students can identify with the accumulation and use of information to further all aspects of our culture.

AN APPROACH

The debate over approaches reaches its greatest impact level when the realities of teacher education are confronted. Those who identify with the study of industry have the security of recent experience and facilities designed for that purpose. Whether or not the addition of the word technology to the word industrial accommodates the mandates of a technological society is mere conjecture. In any case the burden of proof seems to lie on the proponents of the Study of Technology as a discipline base. Inevitably the call comes for an end to the philosophical statements with a request for the identification of content and instructional strategies.

At Eastern Illinois University we have adopted the Study of Technology as our discipline base. This program will be implemented in the fall of 1976. Like technology, it is assumed that it will be a model which is constantly changing and adapting to new information. Those who have worked as a change agent in curriculum modifications realize that each situation has specific constraints (e.g. certification laws, facilities, budgets). The reader should keep in mind that the program was designed to accommodate those constraints which could not be changed. An overview of the program appears on the following page.

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TECHNOLOGY EDUCATION AT EASTERN ILLINOIS UNIVERSITY

TITLE	DESCRIPTION	S.H.
CORE		
Technological Systems	Introduction to the Study of Technology, including the evolution, current status and future of the areas of technology: production, communication and energy.	3
Materials and Processes	Study of the processing of materials used in technical endeavors; natural and synthetic.	4
Communications Technology	Interrelationship of operations in graphic communications.	4
Energy Technology	Study of the processing, converting, transmitting and controlling of energy sources.	4
Production Systems	Study of the necessary systems for three designing and producing in the areas of manufacturing and construction.	3
Computer Programming	Introduction to computer programming	1
Trigonometry	Self-explanatory	2
Physics/Chemistry	Self-explanatory	7
Professional Sequence	Self-explanatory	23
Ascent of Man	Development of science and technology	2
Technical Concentrations (2)	Advanced level work in technical areas	12
	Sub-total	65
GENERAL EDUCATION		
Hours distributed throughout English, Speech, Health, Humanities, Social Studies, and Mathematics/Science		37
*TOTALLY FREE ELECTIVES		18
	Total	120

*Includes such courses as Readings in Technology, Alternate Energy Sources, and specific advanced technical courses.

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It is obvious that traditional laboratories would not handle the proposed program. Therefore, large open-space laboratories are being developed to accommodate the systems approach in each area (production, communication, energy). These laboratories will be utilized via a team-teaching approach utilizing two faculty members and one graduate assistant. The utilization of equipment and materials is planned to be carried out in a flexible atmosphere (e.g. moveable equipment). Long range plans call for a learning resource center to accommodate individual needs. The three main laboratories will be open during one-third of the available time for seminars, individual research, skill development, tutoring and related activities. During this time no classes are scheduled and each laboratory will be staffed. Thus, the laboratory serves as a learning center to accommodate students when they need assistance.

A number of preliminary outcomes have been realized even though the new program will not begin for four months. A few of these are:

- Interest expressed by other disciplines for joint ventures in providing instruction.
- New courses are being accepted in other disciplines to support major requirements in those disciplines.
- Utilization of at least one course (Technological Systems) to meet University general education requirements.
- Unsolicited support given by the University Library to assist in the new program.
- The up-dated undergraduate program served as a springboard for revising the Masters program. This has been approved and will also begin in the fall of 1976.
- Renewed interest in the program by the public schools.

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The end product will be the true test for this new program. One may logically ask why the student will be different than one from a traditional program or one from a program exemplifying the 1960's. The answer to this question can only be answered by the students who eventually will be taught by the new type of teacher. However, a number of assumptions can be made, such as:

- The curriculum is an attempt to present the realities of our culture (technology) without being restrictive. The student will be exposed to the gestalt of the concept rather than to an isolated part.
- The curriculum addresses itself to the socio-cultural aspect of technology as well as to the technical component.
- The curriculum allows for individual differences and enables each student to engage in study relevant to his/her needs.
- The curriculum is future-oriented. That is, it engages questions pertinent to our technological future.
- Education will be dispensed and acquired through a multiplicity of means.
- Students will be able to move within the system, both horizontally and vertically.
- Barriers to learning, common in traditional programs, have been removed (e.g., Obsession with projects, knowledge geared to the past).
- Graduates will receive their B. S. degree as <u>educators</u> rather than as <u>specialists</u>.
- The graduate will understand his culture: its conception, the innovative process which perpetuates it (technology), and will visualize the importance of imparting this to children of the future.
- Students will work in an atmosphere resembling a technological environment (e.g., flexible, efficient, future-oriented).
- Graduates will be responsive to the needs of the clientele they serve. They will be able to cope with diverse models of

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instruction. More importantly they will be able to provide viable input for change.

- Students will see their discipline based on a process rather than on segmented and seemingly unrelated elements.

CONCLUSIONS

Industrial arts teachers and teacher educators can definitely cope with our technological culture. There is identifiable content in the technologies which needs to be presented in a form capable of behavioristic interpretation. The new-born child grows up in a technological culture and must be raised to cope with its mandates. The industrial arts profession is one of the very few disciplines in a position to engage in such education. Although geared to out-dated production systems in many cases, the profession is involved in the three identified areas of technology (production, communication, energy).

The world is facing many serious problems which will require a combination of technical and social solutions. Reference is made to over-population, energy needs, diminishing finite resources, the international quest for affluence, the interdependence of nations, the impact of multi-national corporations, and the total concept of cybernation. To understand one's place in this mosaic seems almost incomprehensible. That mosaic was painted within the past few decades via the accumulation of knowledge and we now need to visualize it as a cultural determinant. The concept of rapid change will not diminish but will continue to escalate. Making sense of this is what the enculturation process we call education, is all about.

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Teacher educators have been bandying the issues long enough. No longer can the debates take place over definitions, over philosophical overtures, or over irrelevant "cop-outs". The youth of today realize that they live in a technological world. They are asking relevant questions at a very early age concerning their culture. To answer them via models of the past does little to help their future focused role image. The term technology is part of their everyday vocabulary and most certainly is here to stay. The literature is replete with discussions of adaptation to the technology as well as every form of mass media. Even our own journals have adopted the jargon of the technologies. It is time that educators identify with the culture of the present and the needs of children of the future. To reject the study of technology is to reject the needs and desires of humans. To present out-moded models cannot survive through this century.

A CALL FOR HELP

It appears to this writer that it is time for the industrial arts profession to pull together to identify content and instructional strategies which will accommodate the needs of humans. Many institutions have programs which are utilizing the study of technology as a disciplinary base. This number is increasing rapidly, thus leaving many programs making the same mistakes. Therefore, I propose that a consortium be established of industrial arts educators who are able to leave personal biases out of curriculum change and who wish to explore the utilization of contemporary and future technology within industrial arts education. This group should engage in professional dialogue to share ideas on a non-threatening basis, seek to

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share ideas rather than hoarding supposed "ultimate answers", and then report to the profession their conclusions. I would suggest that the ACIATE is the logical group to establish such a consortium. Through this process we can end many of the semantic debates and move forward. Let's face it, we need each other. Let's face it, there are no best answers, there are only alternatives.

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